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National Aeronautics and Space Administration

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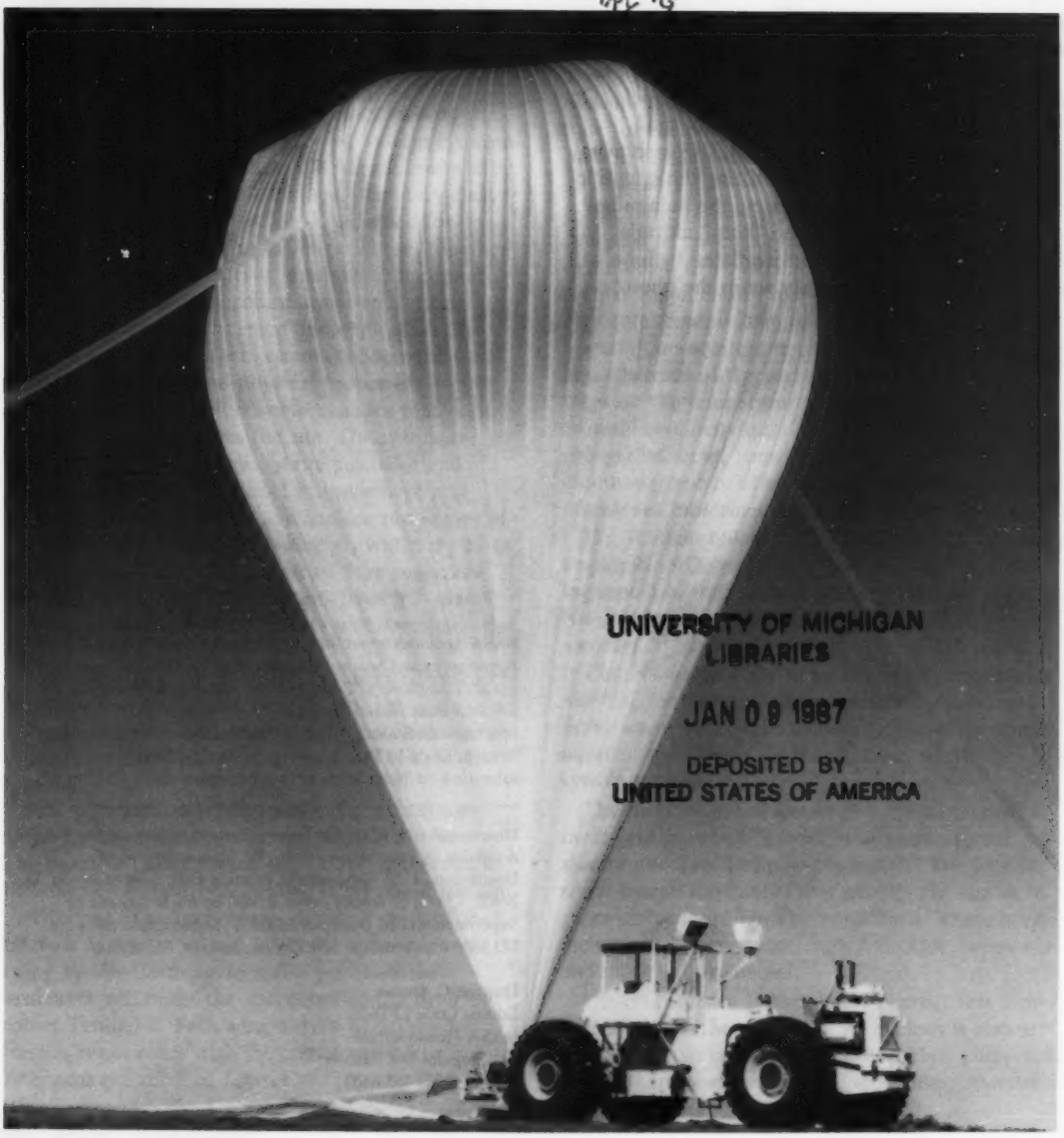

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A 28.4 million cubic feet volume balloon, carrying a 3000 pound payload, utilizing a newly developed balloon grade film designated "Astrofilm 'E'," was successfully launched on June 12, 1986 from the National Scientific Balloon Facility, located near Palestine, Texas. This flight was conducted as part of NASA's Balloon Program which is managed by the Wallops Flight Facility/Goddard Space Flight Center.

The NASA Balloon Program provides support for approximately 50 flights per year to the High Energy Astrophysics, Astronomy, and Upper Atmospheric Research disciplines as well as non-NASA support science programs both national and international.

The balloon, partially filled with helium gas, is held to the ground by the spool-release vehicle. On the ground, the helium occupies only a small fraction of the balloon volume. After release from the spool, the balloon will rise, lifting the scientific payload. As the altitude increases, the helium gas will expand until it reaches the "float" altitude above 1,000,000 feet. The fully inflated balloon will be many times the volume shown in the photo.

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NASA Selects Investigations for Comet Rendezvous Mission

NASA has selected 38 possible investigations for the Comet Rendezvous Asteroid Flyby (CRAF) mission planned for launch in the early 1990's. The mission is designed to send an unmanned U.S. spacecraft to rendezvous with a comet, fly in formation with it for 3 years and fire an instrumented penetrator into the comet's nucleus. The spacecraft also will make close flybys of two asteroids on its way to the comet encounter.

The announcement was made by Dr. Burton I. Edelson, Associate Administrator, Office of Space Science and Applications, who stated, "this selection is particularly important in that it signifies NASA's commitment to the planetary mission strategy recommended by the Solar System Exploration Committee in 1983. The CRAF mission will be the first of a series to utilize a new planetary-class spacecraft, the Mariner Mark II, designed for missions beyond the orbit of Mars. These, together with the planetary observer missions to the inner planets, symbolize our commitment to a strong program in planetary science and exploration."

The CRAF mission will conduct a detailed study of the composition and physical properties of the comet nucleus and will observe changes that occur as the comet approaches the sun. Other mission objectives include analysis of the gas, dust and plasma comprising the comet's atmosphere and measuring the size, shape and surface properties of the asteroids. The CRAF spacecraft will carry 11 to 14 instruments including cameras, dust analyzers and a nucleus penetrator. Results from a 2-year instrument accommodation study will determine the final payload composition.

The scientific goal of comet and asteroid research is to advance man's understanding of the early solar system history by studying those objects believed to have undergone little change since the system was formed.

Several comets and asteroids have been considered as possible targets for the CRAF mission. The baseline plan calls for the CRAF spacecraft to be launched in late 1992 into an orbit about the sun.

After making observations during a flyby of the asteroid Malautra in mid-1993, the spacecraft will swing by the Earth again and a gravity-assist maneuver will boost the spacecraft to the orbit of comet Tempel-2. Following a flyby of asteroid Hestia, rendezvous with the comet will occur in late 1996 near the orbit of Jupiter.

The spacecraft's propulsion subsystem, planned to be provided by the Federal Republic of Germany, will slow the spacecraft and place it in the same orbit as Tempel-2. The spacecraft will fly in close formation with the comet for 3 years, first observing its quiet phase when distant from the sun and then observing the formation of the coma, dust and plasma trails as the comet nears the sun and becomes active. In 1997, the spacecraft will target and release an instrumented probe to penetrate the surface of the comet's nucleus and to make direct measurements of its composition, temperature and surface structure.

Tempel-2 is a short-period comet that circles the sun once every 5½ years, from near the orbit of Mars out to the orbit of Jupiter. If, for some reason, the CRAF mission cannot be launched in time for the planned Tempel-2 rendezvous, other suitable target comets and asteroids have been identified.

The penetrator is a pointed, spear-like projectile designed to penetrate the comet's nucleus to a depth of up to 1 meter. It will carry five instruments: a gamma-ray spectrometer to measure the elemental composition of both ice and non-volatile material; an accelerometer to measure the strength and structure of the surface; thermometers to measure the temperature profile with depth and thermal conductivity; a calorimeter to detect phase changes as an ice sample is heated; and a gas chromatograph to determine the amounts and types of gaseous molecules released from the ice sample.

Dr. William Quaide, Chief Scientist, Solar System Exploration Division, said "clearly, the most exciting aspect of this mission is the penetrator package. No one has ever sent a projectile into the nucleus of a comet."

Comets are thought to be the most pristine and unaltered samples of the early solar system, and many scientists believe comets may contain remnants of the primordial matter from which the solar system formed.

The most accepted model of a comet nucleus is the "dirty snowball" model, a mixture of ices, silicate minerals and possibly metals. The ices are solid, frozen substances that usually are liquids or gases under more familiar conditions. These may include water, methane, carbon dioxide, ammonia and more exotic species.

Observations of Comet Halley earlier this year indicated that the surface of its nucleus is almost black, suggesting the presence of carbon compounds and perhaps complex organic molecules. Asteroids

are small rocky objects orbiting the sun between Mars and Jupiter. They also are believed to be remnants of early solar system material, some may be fragments of larger objects broken apart by collisions.

CRAF mission development and operations will be conducted by NASA's Jet Propulsion Laboratory, Pasadena, Calif. Ronald F. Draper is the project manager and Dr. Marcia M. Neugebauer, the project scientist. The CRAF program is managed by the Office of Space Science and Applications, NASA Headquarters.

New Space Astronomy Technique Developed to Study Celestial Bodies

A new space radio-astronomy technique, using an orbiting satellite to study celestial objects, was successfully tested by scientists at NASA's Jet Propulsion Laboratory, Pasadena, Calif.

An international team of scientists conducted experiments during July and August employing a new space technique called very long baseline interferometry (VLBI). They combined data from radio telescopes on the ground with data from an antenna on NASA's Tracking and Data Relay Satellite System (TDRSS) spacecraft, managed by NASA's Goddard Space Flight Center, Greenbelt, Md.

Investigators obtained better resolution of three quasars than is possible in ground-base radio studies at the same wavelength. Quasars, or quasi-stellar objects, are among the most distant objects known. The resolution obtained from the orbiting VLBI experiment was equivalent to that of a radio telescope with a size of 1.4 Earth diameters. The quasars studied are designated 1730-130, 1741-038 and 1510-089.

For the first time, a VLBI experiment used an orbiting satellite as one of its radio telescopes. Previously, scientists linked widely separated antennae on the ground with VLBI techniques to produce high-resolution radio astronomy studies of celestial objects.

Primarily ground observatories in the experiment were NASA's Deep Space Network 210-foot antenna in Australia and the Institute of Space and Astronautical Sciences' 64-meter antenna at Usuda, Japan. An 80-foot antenna at the Radio Research Laboratory in Kashima, Japan, also was used to check performance of the larger ground antenna.

Researchers believe the experiment's success demonstrates the feasibility of a proposed orbiting VLBI mission. That mission would use a satellite dedicated to radio-astronomy observations and would yield new data on many celestial phenomena, including the nature of galactic nuclei, the overall distance scale of the Universe and the formation of new stars.

The research team led by Gerald S. Levy and other JPL scientists included investigators from M.I.T.; the Haystack Observatory, Westford, Mass.; Bendix Field Engineering Corp., Columbia, Md.; the Spacecom/TRW/Bendix team, White Sands, N.M. and NASA's Goddard Space Flight Center, Greenbelt, Md.

Australian participants were from the Commonwealth Scientific and Industrial Research Organization and Australian National University's Mount Stromlo Observatory. Japanese experimenters were from the Institute of Space and Astronautical Science, the Nobeyama Radio Observatory and the Radio Research Laboratory.

NASA's portion of the VLBI experiment was jointly sponsored by the Office of Space Tracking and Data Systems and Office of Space Science and Applications.

Langley Employees Receive IR-100 Awards

A senior research scientist at NASA's Langley Research Center received an award in the 1986 IR-100 competition for developing one of the 100 most significant new technical products this year.

H. Douglas Garner, a senior research scientist in the Flight Management Division, developed a magnetic heading called a "Smart Compass."

Garner's device was developed to give the aircraft pilot an accurate digital reading of his magnetic heading and to serve as a magnetic heading reference for autopilots or other navigational aids. "The device offers the first simple, economical solution to a long-standing problem in aircraft navigation—that of providing the pilot with an accurate indication of his directional heading that is not disturbed by rough air or by turning maneuvers," Garner explained, "Its use obviates the need for the expensive, high-maintenance directional gyroscope normally installed to supplement the performance of the magnetic compass."

The compass uses a single-chip microcomputer to calculate the instantaneous magnetic heading of the aircraft from the outputs of a specially designed and extremely simple two-axis magnetometer. Garner says provisions are included for compensating or circumventing the usual magnetic compass errors, so that no directional gyroscope is required to supplement the compass readings.

Work at the Langley Research Center over the past few years has been directed toward the development of a low cost, compact, low maintenance instrument to replace the magnetic compass, directional gyro combination, which, though effective, is beset by typical gyroscope problems. The directional gyro is expensive, heavy, had a short operational life between overhauls, and requires periodic resetting by the pilot to correct for drift.

H. Douglas Garner, a senior research scientist in the Flight Management Division, holds a magnetic heading sensor called a "Smart Compass," which he developed to give the aircraft pilot an accurate digital reading of his magnetic heading and to serve as a magnetic heading reference for autopilots or other navigational aids.

According to Garner, conventional magnetic compasses suffer from a number of problems which make useful reading difficult or impossible in rough air and maneuvering flight. " 'The Smart Compass' avoids damping problems, since it employs no moving parts," explained Garner. "Its sensing element can be mounted remotely from the indicator to avoid errors due to local magnetic fields in the cockpit, and it includes circuitry for compensating 'northerly turning error,' which causes large errors in conventional compasses due to the influence of the vertical componment of the earth's magnetic field during banked turns."

Garner's device was placed on public display at the Experimental Aircraft Association's International Convention at Oshkosh, Wisc., in 1985, where it stimulated a great deal of interest from both pilots and builders.

Two engineers at Langley and the executive vice president of KineticsSystems Corporation also received awards in the 1986 IR-100 competition for developing one of the 100 most significant new technical products this year.

Daniel J. Crawford and Richard O. Staib of Newport News, Va., and Robert T. Cleary of Lockport, Ill., developed a data acquisition and control system for upgrading the Langley flight simulation facilities. Other applications of this system are expected in high energy physics studies and fusion research.

Crawford, Staib and Cleary developed the KineticsSystems Model 9450 Data Acquisition and Control System (DACS), which is an ultra high-speed distributed system for real-time data acquisition and control. The network conforms to an international high-speed network technology called Computer Automated Measurement and Control (CAMAC).

This system was developed by KineticSystems in conjunction with personnel at Langley to support the new distributed analog and digital interface between NASA's CYBER computers and 25 flight simulator sites. The data acquisition system which won the IR-100 award is a component of the larger Advanced Real-Time Simulation (ARTS) system, scheduled to begin service at Langley in 1987.

According to the developers, each network in the data acquisition system acquires flight control commands (input data) from piloted simulator cockpits and delivers the data to a large scientific computer. After the computation of the aircraft's dynamic response, the network delivers the output data to the various displays and other devices that cue the pilot(s). The developers describe this process as cyclical with periods as short as five milliseconds.

The effective time-critical rate for transporting the input and output data approaches 24 million in-

formation bits per second, using the new technology. According to the developers, this is three to ten times the effective rate that even the fastest competitive real-time networks can provide. The combination of high throughput fiberoptic links and dynamically switchable networks is unique to this newly-developed system.

Crawford and Staib of Langley's Analysis and Computation Division said they examined various alternatives for the new ARTS system, such as networks in use at aircraft manufacturers and other NASA centers, as well as in the computer industry. None of the other networks studied met the overall performance requirements for the new ARTS system.

Daniel J. Crawford, James R. Haasl and Richard O. Staib stand in front of the data acquisition and control system developed for upgrading Langley's flight simulation facilities. Crawford and Staib, along with Robert T. Cleary (not pictured), received awards for their development at the IR-100 awards luncheon September 25. Crawford and Staib are engineers in the Analysis and Computation Division; Cleary is the executive vice president of KineticsSystems Corporation, Lockport, Ill; and Haasl is the lead engineer from the Kennedy Space Center.

Two aerospace technologists at Langley and the director of safety for United Airlines also received awards in the competition.

Dr. Charles E. Knox and Dan D. Vicroy of Langley's Flight Management Division and Capt. David A. Simmons of Chicago, Ill., developed a simple, airborne flight-management descent algorithm.

The newly developed descent algorithm flight software can be used by all operators of jet powered aircraft for conducting fuel-conservative, 4-D (3-dimensional path plus time control) descents.

According to the inventors, the software provides open-loop, fuel-conservative descent guidance that will meet the time constraint for crossing a geometrical fix as designated by the air traffic control system. They said that no commercially available flight management systems are certified with the 4-D capability at the present time.

Pilots today use various rules of thumb to plan their descents. Some methods are very simple; others are more extensive. However, all methods require some computations, and therefore result in a higher mental workload for the pilot. The flight management descent algorithm was found by the pilots to be very useful and did not interfere with their normal flight duties.

The algorithm also will bring a more consistent nature to the descents from cruise, thereby improving the traffic flow into the terminal area. It has been estimated by one major airline that approximately $616,000 could be saved annually for each mile of improvement in planning where to start the descent.

The algorithm has been programmed into a small calculator. It can be operated in either a time mode or speed mode. The time mode was designed to aid the pilot in planning and executing a fuel-conservative descent to arrive at a time designated by the air trafic control system. The speed mode was designed for planning fuel-conservative descents when time is not a consideration

Capt. David A. Simmons, director of safety for United Airlines, holds the descent calculator used for planning fuel conservative descents. In the cockpit with Simmons are Dr. Charles E. Knox (left) and Dan D. Vicroy, aerospace technologists in Langley's Flight Management Division.

The developers said 4-D flight guidance will become a requirement for aircraft operators as time-based aircraft metering procedures are expanded by the Federal Aviation Administration. Time-based metering is now used at several busy terminal areas in the United States.

In the past 19 years of NASA's participation in the IR-100 competition, 70 NASA developments have been selected, contributing significantly to the recognition of NASA as one of this country's centers of technical excellence. Langley has earned 13 of NASA's 70 awards and the Lewis Research Center leads with 52 awards. NASA ranks third on the list of IR-100 award recipients.

The IR-100 winners were honored at an awards banquet at the Museum of Science and Industry in Chicago September 25. The banquet marked the beginning of a month-long exhibit of products to be viewed by scientists, engineers, educators and the general public.

The Future Spacesuit

Two items which often drive the design of space hardware—safety and cost effectiveness—are driving work at JSC to develop a new spacesuit for use on board the Space Station.

Conservative estimates indicate that there will be more EVAs on board the Space Station than is presently the case on the Space Shuttle. According to Mike Rouen of the Crew Systems and Thermal Division, this estimate was part of an early cost trade-off study to determine whether a new spacesuit was required for the Station. Rouen said that for the extensive EVA expected for such things as payloads and station maintenance, "it makes a lot of sense to develop a new spacesuit."

The suit being developed is a zero-prebreathe suit. Presently, astronauts aboard the Shuttle must go through a time consuming pre-breathe session to remove nitrogen from their bodies before undertaking EVA. The prebreathe session requires either having the EVA crewman breathe 100 percent oxygen for up to four hours prior to an EVA, or decreasing the Shuttle's cabin pressure to 10.2 psi for approximately 12 hours, and then breathe pure oxygen for 40 minutes. Either procedure is time consuming and interrupts other activities and experiments on the Shuttle. Just as importantly, the prebreathe session reduces the ability of the crew to respond to emergencies which require contingency EVA. Rouen said since the EVAs expected for the Station will be greater than those currently undertaken aboard the Shuttle, the inconvenience and cost associated with prebreathing is multiplied many fold.

"We expect up to 1,000 hours of EVA each year per suit once the Space Station is permanently manned. Since the prebreathe session uses up time on orbit—and the costs associated with an hour on orbit are mind boggling—it makes a lot of sense in the long run to develop a new suit which doesn't require prebreathing," Rouen said.

The cost trade-off studies undertaken by Rouen and his colleagues lead to the conclusion that zero-prebreathe suit (ZPS) is needed in the long run, but Rouen said the new suit will be phased into operation. He said any EVA required for initial Station construction will use present Shuttle suits, but he hopes a ZPS will be available for the Station when it becomes permanently manned. An alternate plan would use Shuttle suits for the first four to five years of operation of the Station.

Rouen said the development schedule of a ZPS is more flexible since it will only take some four years to develop, and it only takes 18 months to two years to make hardware components for the suit. An experimental ZPS being tested now prepares the flexibility in scheduling. The experimental suit demonstrates technology to support the final Space Station readiness schedule. Rouen said the Station Phase B contractors are also exploring new suit technology, with Rockwell subcontracting the work to Grumman, and McDonnell Douglas using Lockheed as a subcontractor.

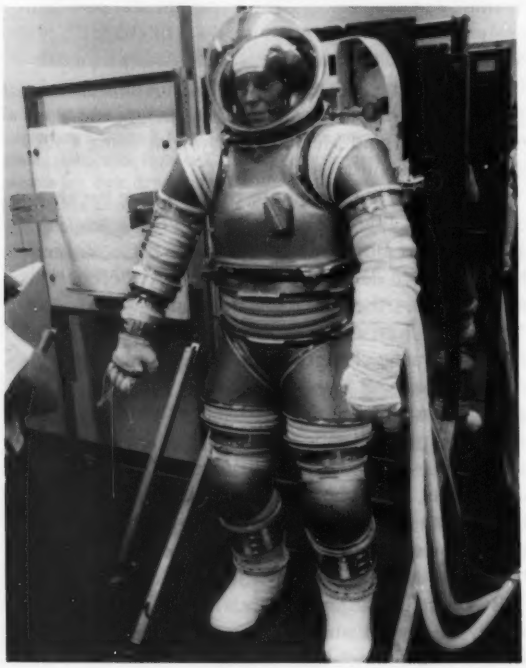
The ZPS does not require prebreathing because it operates at a higher pressure and thus allows astronauts to move immediately into EVA without having to face decompression sickness. Decompression sickness, otherwise known as caisson disease or "the bends," arises when the body is exposed to a rapid or drastic changes in pressure. Body tissues contain dissolved gasses, principally nitrogen, in equilibrium with ambient pressures. When the outside pressure is dropped, nitrogen bubbles form in body tissues. If the pressure drops slowly in small increments, the bubbles are carried away by the blood to the lungs. If the pressure reduction is rapid or extensive, the gas bubbles become trapped in the body's tissues, giving rise to "the bends."

By operating at 8 psi, instead of the 4.3 psi at which the Shuttle suit operates, the pressure drop from 14.7 psi is not great enough to lead to

decompression sickness. The higher suit pressures do impose some problems, however. For one, the suit must be more sturdy and must be carefully designed so it is not more difficult to move in.

"It's like bending a balloon, the more air in the balloon, the more difficult it is to flex it. But if you place rubber bands around the balloon, it's easier to flex," Joe Kosmo, also of the Crew and Thermal Systems Division, said. He added that one key aspect of the ZPS technology demonstrator suit is to find which joints are tough enough to withstand the higher operating pressures but don't excessively constrain the astronaut's motion.

Kosmos said a number of joints, ranging from toroidal convolute elbows to rolling convolute shoulders, have been developed to cope with this problem. He explained that these joints, which contain both fabric and metal rings, maintain flexibility because they maintain a constant volume of gas in the suit. As the top of a suit's joint is compressed, the joint is constructed so that the bottom expands. If the bottom did not expand, the pressure in the suit would increase, making further movement difficult. Kosmo said that one key technology for the ZPS is to develop a glove that will both handle the 8 psi pressure and still provide the flexibility and touch-sensitiveness that astronauts need.



Since the ZPS needs to be more sturdily constructed, it will probably weigh 50 pounds more than the Shuttle suit. The hard and semi-hard ZPS components will also occupy more volume than present Shuttle suits. These two factors will impose launch and storage constraints on the suit, but Kosmo believe these constraints will be more than compensated by the fact that individual joints, instead of entire arms or legs, may be replaced or stored in small areas. "These benefits should more than offset the initial individual weight and storage volume penalties," Kosmo said.

The technology demonstration phase of the ZPS is progressing well, and several different types of joints have been developed. The ZPS test suit developed uses a mixture of past, present and future technology as new arms and legs are tested on a Shuttle upper torso shell. These suit joints were developed using Apollo technology developed when NASA investigated a higher pressure suit for more lengthy stays on the lunar surface.

The job now facing Kosmo and others working on the suit is to determine which configuration of the ZPS is best. The final suit should allow freedom of motion with a minimum of effort. A number of tests are being conducted by co-operative education students to ensure this. One test used light emitting diodes placed on various locations of the suit, like the elbows and cameras in a darkened room to measure the reach envelope afforded by different joint designs. Another test used a medical device used for treating those with hand and upper arm disabilities. The device measures the torque and power a person applies to perform certain tasks. Finally, another device measures how the torque applied to a glove or joint varies with the angle of extension. "We want to develop a quantitative way to determine which joints and gloves are best," said Mariann Farquhar, a co-op student working on the ZPS study. The information gained from such a study will be used by more than the developers of the ZPS. "We expect satellite makers will use the data so that they won't make satellites which can't be worked on by astronauts," Kosmo said.

To perform these tests the suit has been pressurized up to 8 psi above the surrounding air pressure. Kosmo said they expect to have a suit ready for testing in the Weightless Environment Test Facility (WETF) by late 1987, and a suit rated for a pressure chamber will be available after that.

So a new suit is needed to handle the higher pressures associated with a ZPS, and a new life support system (LSS) is needed to meet Space

Station requirements as well. Rouen said the new suit will operate autonomously, although an umbilical may be used for EVA-intensive activities like satellite servicing. "The life support system for a suit is patterned after the space vehicle's characteristics. For example, on the Shuttle the fuel cells produce water, so we use this water to cool the astronaut by venting the water into space. But we don't want to have a cloud of steam around the Space Station, so we're looking into using either ice or wax for cooling on the new suit," Rouen said.

Rouen explained that blocks of ice or wax would be formed on the Station and then placed in a portable life support system. Water would then be circulated around the block to cool the astronaut. Rouen added that the system needed the flexibility to heat the astronaut because, "We've found that when an astronaut gets out of the Shuttle's payload bay, he often gets too cool, and we need to account for this in the new suit,"

The LSS must also provide the astronaut with oxygen and filter out trace gases. While the present Shuttle suit uses lithium hydroxide to filter out carbon dioxide, Rouen said they are looking into a solid amine and liquid absorbent system for the ZPS. Two requirements for the Station suit, that the suit's LSS be regenerable and servicable on orbit, are driving investigations into this area. To integrate the LSS with the ZPS, Rouen said they are investigating ways to provide a heads-up display with information from the LSS to the astronaut. With this, the astronaut can look up into his visor to check the status of his LSS instead of looking down at his chest as on the present Shuttle suit.

Finally, after an EVA, the suit will need servicing. This poses a unique challenge, and Rouen said the servicing area needed on the Space Station to service and check out the suit may be as difficult to build as the suit's LSS. Rouen said this will be a vital part of the new suit's system because present Shuttle suits are only rated to operate 21 hours before on-the-ground servicing. Although Rouen said this number is expected to double soon, it doesn't approach the 1,000 hours expected before on-the-ground servicing required for the Space Station. But this just once again leads to the conclusion that for the extensive EVA eventually planned for the permanently manned Space Station, a new space suit system must be developed.

From The Congressional Record

The following comments were provided by Senator Larry Pressler on NASA spinoffs

The U.S. Space program is at a crossroads. With the loss of the space shuttle *Challenger* in January and the destruction of the Delta rocket, Congress, NASA, and the public are conducting an intensive evaluation of the methods and goals of our Space Program. Such an inquiry is necessary to determine and correct the causes of those mishaps. I am confident that NASA can correct these problems, particularly under the leadership of its new Administrator, Dr. James Fletcher. I have no doubt that after this review is completed the Space Program will be stronger than ever, and we will be ready to continue our exploration of outer space. The benefits our country receives from the Space Program make it especially important that we continue to move forward in this area.

Those benefits are threefold: the expansion of our knowledge about space and the worlds around us; the contribution of space science and technology to our national defense; and the application of space technology to products and processes here on Earth. The first two topics have been covered in great detail many times before and do not need to be repeated now. I would rather discuss the civilian and commercial applications—or spinoffs—of space technology that have been developed during the long journey from the launch of Explorer 1 to the launch of the space shuttle.

The technology NASA has developed to meet its research goals and program needs represents an important national resource. It is a store of technical knowledge and innovation that can be applied to develop new products and processes for the benefit of our health and welfare, industrial productivity, and overall economic strength. At present, NASA has patented almost 4,000 aerospace inventions which are available for licensing for commercial development. In addition, an estimated 30,000 secondary applications of space science technology have emerged in the past 28 years.

These inventions and innovations cut across a variety of disciplines and economic sectors. A sampling of that list indicates the breadth of this technology transfer and includes the following fields: industrial productivity, environment, construction, public safety, energy, medical instrumentation, management systems, consumer products and computer applications.

Many of the innovative products now being used in the construction industry are direct spinoffs of materials NASA developed in order to reduce costs and protect its equipment. For example, in order to reduce maintenance costs for gantries and other structures at the Kennedy Space Center, a new coating was developed that would resist salt corrosion and protect the launch structure from the extremely high temperatures of rocket exhausts. This compound is now being used to protect bridges and commercial structures from the wear and tear associated with prolonged exposure to the elements.

In a similar vein, NASA needed to develop a new fabric for astronaut space suits which had to be durable and inflammable, yet thin, light, and flexible. In conjunction with a major manufacturing company, NASA developed a material, woven from glass fiber yarn, which was coated with Teflon and tailored into space suits. A heavier adaptation of that fabric is now being used as a canopy covering shopping centers and sports stadiums—including the University of South Dakota's DakotaDome at Vermillion. The material's unique qualities reduce the need for artificial lighting and help lower cooling costs.

Consumers will also recognize a number of everyday products which apply space science developments generated by the Space Program, including scratch resistant sunglasses and lightweight sports equipment.

NASA innovations have also been applied to public safety. Application of the technology used to develop high capacity rocket engine pumps, lightweight material, and compact packaging, has resulted in a high-capacity firefighting pump the city of Miami uses for shipboard and harbor fires.

During the Apollo Program, NASA found a need to develop special high intensity lights to simulate the effect of sunlight on the spacecraft and its occupants. This technology was the foundation for a line of products now used by law enforcement agencies for search and surveillance activities. Other space science safety developments include cockpit voice synthesizers which warn airline pilots of impending danger, and fire resistant materials used in a variety of products.

Perhaps the most spectacular advances resulting from the U.S. Space program have occurred in the field of health and medicine. Technologies adapted from both the manned and unmanned programs have been converted into lifesaving mechanisms that are used by people in all stages of life. A process that monitors astronauts' vital functions from the ground has been adapted to help diagnose and treat patients who experience difficulty walking due to birth defects, disease, or injury. Spinoffs from the miniturization required in space flight include the heart pacemaker—which prevent thousands of deaths annually—and tiny pumps that continuously release medication inside the body. Finally, the space imagery techniques developed and refined for Earth observation satellites such as Landsat—which has played such an important part in the EROS Data Center in South Dakota—are being applied to enhance sophisticated diagnostic x-rays that would otherwise be difficult, if not impossible, to decipher.

I have taken the time to describe just a few of the many benefits our society has realized from the Space Program to make the point that we derive much more from space exploration than merely increased knowledge of the stars above. Not only do we increase our basic knowledge of the world around us and the worlds beyond, we also develop new products and processes that can be applied in all aspects of our life here on Earth. I hope that all of us in Congress and the public at large will keep this in mind as we continue to discuss the future direction of our Space Program. I am fully confident that the National Aeronautics and Space Administration, under the able direction of Dr. Fletcher, will continue its exemplary work in the development and application of technological innovations.

Robots of the Future?

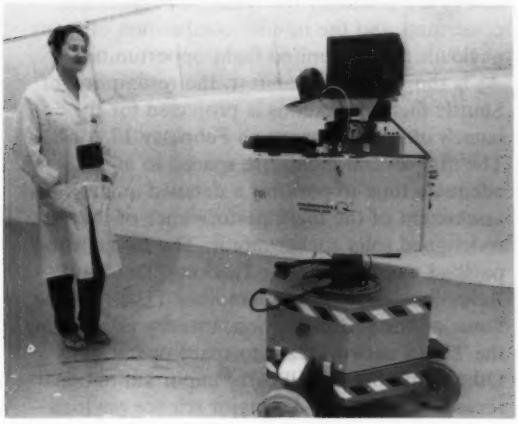
A self-guided robot, which is an early developmental model for future Space Station robots, is being tested in the Tracking Techniques Branch, Tracking and Communications Division, at the Johnson Space Center, Houston, Tx. and also was displayed at the Engineering Exposition July 30 and 31.

The Tracking Techniques Branch is working on robotic servicing as part of an overall robotics

development effort headed by NASA's Goddard Space Flight Center. The Branch is developing tracking and vision systems for use by robots on board the Shuttle as well as the Space Station.

NASA plans to use robots on Space Station for a variety of routine 'outside" jobs. Robots will be used for inspection and maintenance on Space Station, to assemble Space Station payloads such as free-flying platforms or large telescopes, or to retrieve and repair satellites.

Robots also will be used for remote controlled jobs with astronauts giving commands and the robot performing the tasks. This will allow complicated work to be done at remote locations, such as a polar-orbiting platform, without the astronaut's presence.



A robot uses a McDonnell Douglas developed sensor on top of a JSC developed base to follow Anne Marie Ching. The robot uses a video sensor to follow Ching by tracking the contrasting black square on Ching's white lab coat.

Space Station tasks will require robots to track moving objects, and the sensor demonstration robot has that capability. The robot is a tracking system on a mobile platform which uses long and short-range television cameras as "eyes." It is approximately five feet tall and three feet wide and weighs approximately 450 pounds.

Robots sent into space will be more compact, lighter and slimmer. They will be proportionately similar to humans, so they can use the same tools and equipment astronauts use. For example, robots and astronauts will wear the same size manned maneuvering units for extravehicular activities. That way, NASA will not have to design special equipment for the robots.

NASA and You

Combining Work and Family

Working Parent, there are ways to lessen the load you are carrying! Here are some suggestions:

- Learn to recognize your own individual signs of stress (extra irritability, headaches, overeating). Try to slow down for a day or two. Identify what is causing the stress (work, relationship, kids, home, self?), and make what changes you can.
- Think about your goals and expectations and the goals and expectations others have for you. Are they realistic and reachable? If not, try to change them.
- Monitor (and limit) the number of responsibilities you take on at one time. For example. If your home life is pressured, try to limit social or work commitments until things settle down.
- Also, analyze your day and its most stressful times. Limit the number of activities during these times.
- If you feel guilty having your children in child care, try to remember that there is no one correct way to parent and you are not the only person who can meet your child's needs. Your importance will not be diminished by sharing your parenting role.
- Talk to your family about what you are feeling. Partners and children are often willing to help when they understand what is going on with you. The same is true for co-workers and bosses. Give them an opportunity to help and support you.

Are you a working parent, trying to juggle your family, job, home, relationship, and your own needs? Do you often feel tired and overburdened, split in many directions, disorganized, and guilty? If so, you are not alone. Just about everyone who is working and taking care of a family feels this way at one time or another. No matter how organized you are, stress is an inevitable part of life, and can be broken down into four areas:

- **Practical**—Time and energy limits make it impossible to do all the things you want and feel you should do at home. There are so many details in your lives and lives of your family that stress results from trying to manage them all and work too.
- **Work**—Every job has its own demands (busy

times, difficult tasks, request for extra involvement) which creates stress. If these demands come at a time when there are family demands, even more stress results.

- **Interpersonal**—You often do not have much time for socializing. Friends or family may not understand your dilemma, and feelings of isolation and stress can occur. Intimate relationships may also suffer when both partners work and have little time to nurture their relationship.
- **Self**—Most working parents (particularly women) feel some guilt about the need or choice to work and be away from their families. These feelings cause stress and often result in working parents trying to do everything perfectly and blaming themselves when they can't be "superpeople."

by Susan Zweig, Ames

National Space Transportation System Manifest

- The following manifest is a projection of anticipated flights of each Shuttle orbiter with specific major payload assignments. Secondary payloads will be assigned on a space-available basis at a later date.
- The President's recent decision on space commercialization is reflected in this manifest. NASA shall no longer provide launch services for commercial and foreign payloads subject to exceptions for payloads that: (1) are Shuttle-unique; or (2) have national security or foreign policy implications. This manifest is being released with the expectation that current customers who are not included will voluntarily seek launch opportunities elsewhere. NASA intends to invite these customers to meet with NASA officials to discuss their transition.
- Because of the two-year downtime and the reduced flight rate resulting from the loss of Challenger, a substantial backlog of payloads will exist for some time. This backlog will be reduced by utilizing the STS and ELV missions, military and civil.
- The generic priorities for payload assignments were:
  - — National Security
  - — STS operational capability (TDRS), dedicated science payloads
  - — Other science, and foreign and commercial
- Other factors which influence the manifest include:
  - — Difference in capability of specific orbiters
  - — Turnaround of airborne support equipment
  - — Planetary launch windows
  - — The post-accident reassessment of Shuttle flight rate capability
  - — The cancellation of the Shuttle/Centaur upper stage
  - — The standdown of the Vandenberg Shuttle launch complex until 1992
- The combined effect of these factors means that flight of most payloads are delayed more than the two-year downtime with some payloads being delayed for three or more years. Such large delays are primarily the result of manifesting constraints and the intense competition of many payloads for the limited flight opportunities.
- As is shown in the manifest, the resumption of Shuttle flight operations is projected for the launch of the Discovery on February 18, 1988. The first several flights are spaced to allow adequate time to perform a detailed analysis and assessment of the flight performance of the redesigned solid rocket motor. The first mission payload will be a NASA Tracking, Data and Relay Satellite (TDRS). Another TDRS will be flown on the fourth mission, thereby establishing the TDRS network vital to space operations. Other early flights will carry important national security payloads and a major science payload—the Hubble Space Telescope and Astro-1 (Astrophysics Science).
- The second twelve months of operations continue NASA's efforts to reduce the backlog of national security payloads and to support Magellan (Venus Radar Mapper) and a second planetary mission. This period also includes the first opportunity to fly a DOD Global Positioning System navigation satellite (GPS NAVSTAR). This 12 months will also see the launch of a major NASA Life Sciences Spacelab mission, as well as Astro 1 (Astrophysics Science) and the Gamma Ray Observatory.
- The third year reflects the continuing effort to reduce the backlog of national security payloads, the flight of several science missions, another planetary mission, and the accommodation of additional GPS NAVSTAR satellites. Beyond the first 3 years, flights are projected by quarter only. The planetary missions referred to in the manifest include Ulysses, Galileo, and Mars Observer.

Flight Schedule for 1988

Flight Number	Date Orbiter	Incl Alt	Crew Duration	Payload	Carrier
26	02/18/88 Discovery	28.5 160	5 4	TDRS-C	IUS
27	05/26/88 Atlantis	0.0 0	0 0	Department of Defense	
28	07/28/88 Columbia	0.0 0	0 0	Department of Defense	
29	09/22/88 Discovery	28.5 160	5 4	TDRS-D	IUS
30	11/17/88 Atlantis	28.5 320	5 7	HST	

Flight Schedule for 1989

Flight Number	Date Orbiter	Incl Alt	Crew Duration	Payload	Carrier
31	01/19/89 Columbia	28.5 190	7 7	Astro-1	IG+2P
32	03/02/89 Discovery	0.0 0	0 0	Department of Defense	
33	04/25/89 Atlantis	28.5 110	5 4	Magellan	IUS
34	06/02/89 Discovery	0.0 0	0 0	DOD Spacelab	LM
35	06/21/89 Columbia	28.5 160	5 7	GPS-1 GPS-2 MSL-3	PAM-D2 PAM-D2 MPESS
36	07/20/89 Atlantis	0.0 0	0 0	Department of Defense	
37	09/01/89 Discovery	0.0 0	0 0	Department of Defense	
38	09/21/89 Columbia	28.5 160	5 5	GPS-3 GPS-4 MSL-4	PAM-D2 PAM-D2 MPESS
39	11/01/89 Atlantis	28.5 110	5 4	Planetary Oppty	
40	12/07/89 Discovery	57.0 160	7 7	SLS-1	LM

Flight Schedule for 1990

Flight Number	Date Orbiter	Incl Alt	Crew Duration	Payload	Carrier
41	01/18/90 Columbia	28.5 200	5 4	GRO	
42	02/15/90 Atlantis	0.0 0	0 0	Department of Defense	
43	04/20/90 Discovery	28.5 160	7 7	IML-1	LM
44	05/04/90 Columbia	28.5 160	5 7	GPS-5 Pathfinder EOS-1 Share	PAM-D2
45	05/31/90 Atlantis	0.0 0	0 0	Department of Defense	
46	07/12/90 Discovery	0.0 0	0 0	Department of Defense	
47	07/26/90 Columbia	28.5 160	5 7	GPS-6 Skynet-4 MSL-5	PAM-D2 PAM-D2 MPESS
48	08/31/90 Atlantis	0.0 0	0 0	Department of Defense	
49	10/05/90 Discovery	28.5 110	5 4	Planetary Oppty	
50	10/25/90 Columbia	28.5 160	5 7	GPS-7 INSAT-1D TSS-1	PAM-D2 PAM-D
51	11/15/90 Atlantis	28.5 200	5 7	LDEF Retrieval Syncom IV-5	

Flight Schedule for 1991
(Partial Schedule)

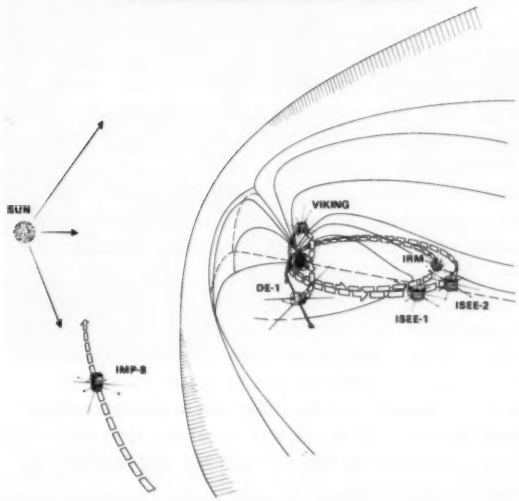
Flight Number	Date Orbiter	Incl Alt	Crew Duration	Payload	Carrier
52	01/17/91 Discovery	57.0 160	7 7	Atlas-1 COFS-1	1G+2P Pallet
53	02/14/91 Columbia	28.5 160	5 7	GPS-8 GPS-9 MSL-6 SSBUV-1	PAM-D2 PAM-D2 MPESS
54	03/01/91 OV105	0.0 0	0 0	Department of Defense	
55	04/04/91 Atlantis	28.5 160	5 7	GPS-10 SKYNET-4 EURECA	PAM-D2 PAM-D2

Did You Know?

NASA spacecraft launched in 1973, 1977, and 1981 have played central roles in an intensive international campaign to increase man's understanding of the plasma processes by which solar variations yield auroras and other effects in the Earth's environment. The campaign, named PROMIS (Polar Region and Outer Magnetosphere International Study), involved a data acquisition phase (March-June, 1986) and a subsequent data analysis phase.

PROMIS capitalized on the unusually favorable configuration of spacecraft in, and beyond, the Earth's magnetosphere (that vast and complex region of space threaded by geomagnetic field lines). The NASA contributions to this spacecraft constellation consist of IMP-8 (Interplanetary Monitoring Platform), ISEE-1 and -2 (International Sun Earth Explorer), and DE-1 (Dynamic Explorer). The additional spacecraft, Viking, IRM (Ion Release Module, part of the AMPTE mission), and ISEE-2 are from Sweden, Germany, and ESA (European Space Agency), respectively. All these spacecraft are instrumented to measure electric and magnetic fields, plasmas, and energetic charged particles. In addition, the DE and Viking spacecraft carry imaging systems by which auroras are imaged from above.

PROMIS SPACECRAFT CONFIGURATION



This constellation of spacecraft measures variations of the solar wind as it impinges on the magnetosphere (IMP-8), the resultant energy and plasma accumulation and release in the magnetotail (ISEE-1, ISEE-2, IRM), and the deposition and dissipation of this energy by auroal and other processes deep within the magnetosphere (DE, Viking).

The PROMIS effort was conceived by Dr. Ed Hones of the Los Alamos Scientific Laboratory. Much of the detailed planning, led by the Project Scientists of the NASA missions, Drs. Joe King, Keith Ogilvie, and Bob Hoffman, all of Goddard, involved the identification of several periods of several hours each when the relevant spacecraft were in particularly favorable locations. Much support was provided by the National Space Science Data Center's Satellite Situation Center (NSSDC's SSC) and "Sardi" Parthasarathy during this and later phases. (See figure 2.) Support from NASA Headquarters, especially Drs. Shelby Tilford and Stan Shawhan of the Office of Space Science and Applications and from Mr. William Bastedo and Mr. James Costrell of the Office of Space Tracking and Data Systems, resulted in an adjustment of the ground telemetry acquisition stations' priorities, so that most of the requested concurrent coverage (many hundreds of hours) was obtained. Excellent support was received from Goddard's Mission Operations and Data Systems Directorate.

The data analysis process will have two phases. First, a panel of scientists representing the various spacecraft involved and related ground-based data sources will identify those intervals characterized by both good data coverage and the occurrence of interesting geophysical activity. (Time intervals which are either too quiet or too complex are not optimal for yielding new scientific results.) Next, an intensive analysis of the many data sets available for the selected events will be pursued by many NASA, other U.S., and international scientists. A significant tool in this analysis will be the NSSDC Coordinated Data Analysis Workshop (CDAW) software package.

PROMIS is an exciting campaign which seizes on a target of opportunity and which is expected to lead to significant advances in solar terrestrial physics at minimal cost. PROMIS will build on the multipoint measurement approach initiated in the ISEE and DE programs in understanding the complex solar wind/magnetosphere coupling in the dynamic geospace environment. As such, PROMIS is a pathfinder for the International Solar—Terrestrial Physics (ISTP) Program proposed for the early 1990's.

Mr. Dale D. Myers was appointed by the President as Deputy Administrator of NASA. Mr. Myers succeeds Dr. William R. Graham who left NASA to become Director of the White House Office of Science and Technology Policy.

Myers previously served as an at-large member to the NASA Advisory Council, the organization created to provide advice and counsel to NASA top management on aeronautics and space programs. From 1984 to 1986, he was a private consultant in Aerospace and Energy. From 1979 to 1984, he served as President and Chief Operating Officer of the Jacobs Engineering Group, Inc., in Pasadena.

Myers was Under Secretary of the U.S. Department of Energy from 1977-1979. From 1974-1977 he was Vice-President, Rockwell International and President, North American Aircraft Group, El Segundo, California. He was the Associate Administrator for Manned Space Flight at NASA from 1970-1974. From 1969-1970 Mr. Myers served as Vice-President/Program Manager, Space Shuttle Program, Rockwell International. He was Vice-President and Program Manager, Apollo Command/Service Module Program, North American-Rockwell from 1964-1969.

Myers was born in Kansas City, Missouri, on January 8, 1922. He graduated from the University of Washington, Seattle in 1943 with a B.S. degree in Aeronautical Engineering and received an honorary doctorate from Whitworth College in 1970.

He is married to the former Marjorie Williams of Seattle and they have two children.

Astronaut Frederick D. Gregory, Col., USAF, was named Chief of the Operational Safety Branch, Safety Division, in the Office of Safety, Reliability, Maintainability and Quality Assurance, NASA Headquarters, effective Oct. 14, 1986.

The purpose of this new position is to provide a senior safety manager for agency-wide oversight of NASA space and aeronautic programs operations and research and development and test facilities activities which affect both ground and flight operational safety. Gregory will participate with industry, the Department of Defense and other government agencies in developing policy and criteria to assure safety of personnel, equipment and mission for complex ground and flight operations.

NASA employees and contractors attended the grand opening of the Goddard Space Flight Center Visitor Center's new exhibit area on Monday, October 27, 1986.

The new exhibit area reflects the changes that have taken place in the space program since the Visitor Center was opened 10 years ago.

Designed for children of all ages, the new area will house various interactive exhibits which simulate living in space, working on the space shuttle, and performing scientific and commercial experiments on the space station.

Among other attractions, visitors will be able to sit in a mock-up of a Manned Maneuvering Unit—used for propelling astronauts during their excursions outside the shuttle—and simulate the operation of the vehicle, sign up to have their name carried into space, or sit in a gyro chair and feel what it's like to navigate and control a spacecraft.

The centerpiece of the new hall will be an eight-screen visual presentation highlighting a window into space.

After an intensive study, NASA determined that the redesigned Space Shuttle Solid Rocket Motor (SRM) will be test fired in a horizontal attitude. This test attitude best simulates the critical conditions on the field joint which failed during the STS-51-L mission.

NASA also will conduct extensive component tests, full-segment joint environmental simulation tests (with loads applied) and full-scale motor static tests to verify and certify the redesigned motor for flight. Also being considered at this time is the construction of a second horizontal test stand with the capability of simulating launch and flight loads on the motor during static test. This second horizontal test facility, which should be ready for use in about 12 months at a location still to be determined, would provide additional test capability and redundancy in case of the loss of the only test facility now available to NASA.

The Presidential Commission investigating the STS 51-L accident recommended that NASA consider the vertical attitude for the motor firings and

duplicate the actual flight conditions as closely as possible. It is NASA's belief that testing in the horizontal attitude is the most demanding test of the redesigned joint for pressure and flight-induced loads and thus best satisfies the Commission's intent.

These findings were reviewed within NASA's technical community, with the Shuttle management's formal review system, an SRM design overview committee composed of NASA and industry experts, and the U.S. Air Force team which is responsible for returning the Titan launch vehicle to flight status. They also were presented to the independent SRM design review panel of experts established under the auspices of the National Research Council.

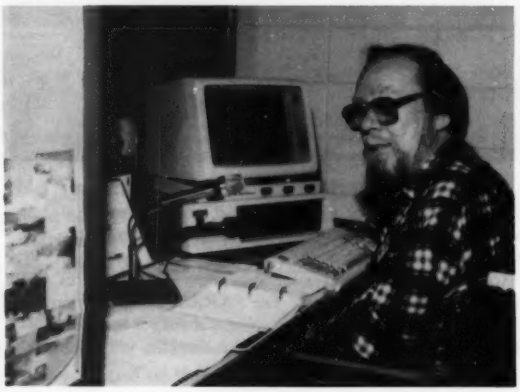
NASA believes that the test plan being implemented will provide the correct basis for flight verification of the redesigned SRM.

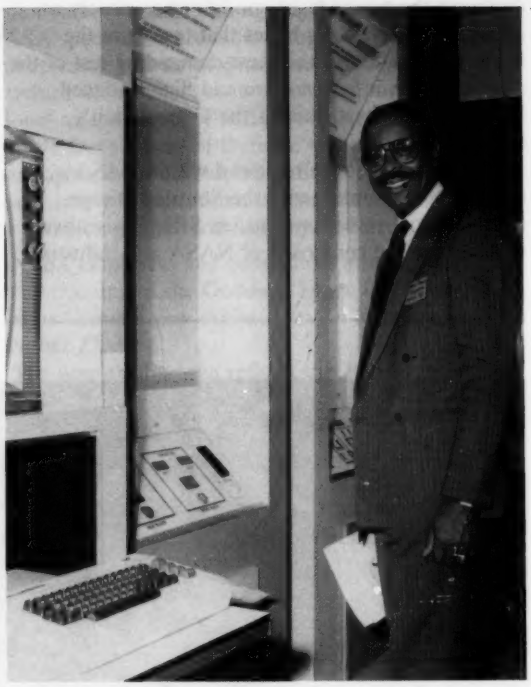
The Rotor Systems Research Aircraft that will be used to test the X-Wing concept developed by NASA and DARPA arrived at NASA's Ames-Dryden Flight Research Facility via the Super Guppy aircraft on September 25, 1986. Flight tests, scheduled to begin later this fall at Ames-Dryden, are a major step in the development of an X-Wing vehicle which could provide both the vertical lift characteristics of helicopters and the high subsonic speed capabilities of fixed-wing aircraft. This photograph, taken in the Edwards AFB Weight and Balance hangar, shows the RSRA/X-Wing just following removal from the Super Guppy. The RXRA/X-Wing program is a joint NASA/Defense Advanced Research Projects Agency (DARPA) effort. The flight investigation program is managed by NASA's Ames Research Center, Moffett Field, California, with flight test at Ames-Dryden. Sikorsky Aircraft, the manufacturer, will conduct the flight program under the direction of Ames.

NASA's Outstanding Handicapped Federal Employee of the Year-1986 is Mr. Lowell D. (Butch) Fair, Jr., who maintains the Automatic Data Processing (ADP) Equipment Inventory for all of NASA's Kennedy Space Center. He must collect information from many different sources at the Space Center and verify its accuracy with relevant procurement and planning documents. Obtaining this information from quasi-autonomous contractors is a challenge that requires initiative and perseverance. Mr. Fair must prepare a list of the changes found in the Center's inventory for transmission to NASA Headquarters and subsequent inclusion in the General Services Administration government-wide data base. The information he supplies is consistently accurate and timely. He interfaces with a large cross-section of NASA and contractor personnel in an unfailingly pleasant manner. He has shown considerable ingenuity in developing innovative methods for performing his task. He received a Superior Achievement Award in 1982 for his efforts in automating his work with the APD Equipment Inventory.

He has combined his personal interest in microcomputers with his work by staying on the leading edge of the advances in Office Automation. He recently completed a project, "Voice Activated Computer Utilization," which demonstrated that voice control is well-suited for the input of highly complex commands, voluminous data, and applications where keyboard entry is awkward. This effort was published in the Kennedy Space Center's "Research and Technology 1985 Annual Report."

Mr. Fair has received numerous agency and community recognition awards and is one of the founding members of Space Coast Association of Physically Handicapped, whose objective is to help and encourage those with physical limitations.





Dr. Robert Brown, Director, Education Affairs Division, NASA Headquarters is pictured with some of the exhibits displayed during the Future Work Force Conference.

"Will the United States remain a leader in productivity and technical development or lag behind other nations?" "Will our children be prepared to meet the technical demands of the future?" "How can the business community help our schools develop skills and motivate young people to excel in math and in science in order to increase the technical and scientific pool of talent?" These were some of the questions addressed by a gathering of approximately 125 representatives at a conference entitled, "The Future Work Force," sponsored by NASA's Office of Productivity Programs and the Educational Affairs Division, NASA Headquarters, held at Goddard Space Flight Center, Greenbelt, Md. September 10-11, 1986.

Some important innovations, tested programs and hard facts were candidly shared by conference participants. Many of those participants believe that the synergism of industry and education partnerships has, does, and will favorably impact the quality of our future work force.

Innovative approaches to enhance the technological curriculum of the future work force were unveiled at the 2-day conference.

As a precursor to this conference NASA met with 20 companies and three of our "Teachers in Space" in April 1986 to consider joint initiatives to impact the nation's school systems. While Goddard was the first Center to host a future work force conference, it is hoped that future conferences will be held at other Centers. NASA fills a valuable niche by bringing education and industry groups together and fostering their entrepreneurial cooperation.

Contractor News

NASA awarded two contracts for high-speed, civil air transport studies, one to **Boeing Commercial Airplane Company,** Seattle, and one to **McDonnell-Douglas Corpóration,** Long Beach, Calif. The total Boeing contract is valued at approximately $4.5 million, the total McDonnell-Douglas contract at $4.4 million.

The two-year contracts will be cost shared with NASA on a 50-50 basis. The contracts contain options to extend the effort and performance period which may result in a potential final cost of approximately $9 million for each contract.

The studies seek to make use of expected technological advances from work on the National Aero-Space Plane program and from continued research on high-speed aircraft in general to satisfy two major objectives. The first objective is to identify the most promising concepts for future long-range, high-speed, civil transport aircraft. The second is to provide information needed to guide NASA planning of technology development.

The two contractors will conduct the work in three phases. The first phase will consist of an initial assessment of potential vehicle concepts, of relevant non-vehicle technologies and of commercial value, ie., economics, scheduling and marketing. The second phase will produce a prioritized list of vehicle concepts. The final phase will focus on one or two of the more promising vehicle concepts per contract.

This work requires an understanding of the economics, flight speeds, size, range, fuel type and technology levels required for the proposed vehicles to become successful major elements in the international air transportation system.

The companies are to take into consideration that continued international growth and economic development into the next century is expected to create a significant market for high-speed, long-range air transportation. Further, that the need to conduct business in areas such as the Pacific basin will place emphasis on minimizing trip time and increasing productivity. Either a hypersonic transport, based in large part on aerospace plane technology, or an advanced supersonic cruise airplane that incorporates emerging technologies could prove to be an attractive and economically competitive vehicle for this market.

The work will provide a fresh look at a wide variety of technical options. While this study can benefit from the lessons learned in past studies of higher-speed transports, it cannot be treated as an extension of previous work.

The work will be peformed at the companies' home locations and will be monitored by NASA's Langley Research Center, Hampton, Va.

NASA's Ames Research Center, Mountain View, Calif., awarded a $9.4 million contract to **Pratt & Whitney,** West Palm Beach, Fla., for research, technology and developmental activities that could lead to a demonstrator supersonic research aircraft capable of short takeoff and vertical landing (STOVL) in the early 1990's.

A key factor in a STOVL aircraft program is development and integration of the propulsion system into the airframe. A propulsion system demonstration in the 1990's would use a derivative of an advanced technology engine, such as the PW5000 engine currently being developed by Pratt & Whitney for the U.S. Air Force.

The study will initially evaluate the integration of an advanced derivative PW5000 engine into four candidate propulsion system concepts. The four concepts under consideration are vectored thrust, ejector augmentor, remote augmented lift system and hybrid tandem fan.

This ground-based research program is a cooperative effort between NASA, the Defense Advanced Research Projects Agency and the U.S. Air Force.

The 3-year contract began in October.

Another Dividend from Air and Space

Research and development in aeronautics and space have provided numerous benefits for all Americans—and at a tiny percentage of the tax dollar. Here is an example:

Blood Pressure Control

In the photo, the model is demonstrating use of the Baro-Cuff, a system typical of that developed for a cardiovascular study of weightless astronauts, it may help people who suffer from congestive heart failure or diabetes. The astronaut experiment was conceived by Veterans Administration Dr. Dwain L. Eckberg; the equipment was developed by Engineering Development Laboratory (EDL), Newport News, Virginia for use on the Spacelab 4 mission as part of a broader Space Shuttle Life Science Experiments program. EDL then conducted an internal research and development program to reduce the complexity of the system and adapt it to Earth-based medical research applications.

During space flight, astronauts experience greater than usual blood pressure and heart rate instability, which sometimes induces postflight lightheadedness or even momonetary blackout, temporary symptoms that gradually disappear, suggesting that weightlessness may impair the body's normal blood pressure controls. In the Spacelab-4 investigation, the Baro-Cuff will be used to study "resetting" of blood pressure reflex controls. A silicone rubber chamber strapped to the neck, the Baro-Cuff will stimulate the carotid arteries by electronically-controlled application of pressure or suction.

Patients with congestive heart failure, chronic diabetes mellitus and other conditions also experience abnormal blood pressure reflex controls. As a medical research tool, the Baro-Cuff will be used to study blood pressure controls and the results of stimulation in such patients.

In 1985, EDL delivered its first Model E-2000 Baro-Cuff System to the Veterans Administration Hospital in Gainesville, Florida, where it is being used in kidney function research. The company has also developed and sold specialized configurations for use by U.S. medical colleges in clinical investigations and is marketing the system to international researchers in the field of cardiovascular physiology.

* NASA does not endorse commercial products developed as a result of its Technology Utilization or Patent Licensing Programs, but it does encourage the widest possible use of its technology.